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# Beet Top Silage *and* Other By-products *of the* Sugar Beet



**T**HIS BULLETIN discusses the more profitable methods of utilizing the tops and other by-products of the sugar beet.

In the Intermountain States there is a shortage of hay and other forage, and the siloing of beet tops will aid in meeting this shortage. The value of sugar-beet tops, molasses, and pulp is becoming more and more generally recognized by feeders of live stock. This bulletin illustrates good methods of constructing pit silos and gathering and siloing the tops. It also makes important suggestions in regard to feeding the silage, molasses, and pulp, based largely upon reports of beet growers and stock feeders.

Most beet growers estimate that beet-top silage has a value about one-third to one-half that of alfalfa hay. The silage is well suited for the dairyman or for the feeder of beef cattle and sheep. When beet-top silage is fed for the production of beef or mutton, the hay requirements may be reduced 50 per cent; furthermore, the warm, succulent silage seems to stimulate the appetite of the animals, causing them to consume and utilize larger quantities of feed.

Beet pulp and molasses, by-products which have an established value with stock feeders, should be fed with a moderate allowance of hay or other feed in order to make a balanced ration. At the present price of beet molasses many feeders are finding a mixture of molasses with hay or with pulp to be profitable. This furnishes variety and stimulates appetite when fed in regulated quantities.

In feeding beet-top silage, about 30 pounds per 1,000 pounds weight for cattle and 3 pounds per head for sheep each day seem to be most satisfactory.

Animals not accustomed to beet-top silage should be given a small quantity at first and the feedings gradually increased until the normal ration is reached.

Contribution from the Bureau of Plant Industry

WM. A. TAYLOR, Chief

Washington, D. C.

December, 1919

# BEET-TOP SILAGE AND OTHER BY-PRODUCTS OF THE SUGAR BEET.

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## CONTENTS.

	Page.		Page.
Beet tops.....	3	Adverse experiences.....	13
Beet pulp.....	3	The best practices.....	14
Beet molasses.....	3	Wet beet pulp.....	20
Seed beets.....	4	Dry beet pulp.....	21
Beet tails.....	4	Utilizing beet molasses.....	21
Ratio of tops to roots.....	4	Digestible nutrients and balanced ra- tions.....	21
Observations of a beet grower.....	4	Management of seed-beet fields.....	22
Saving the hay.....	5	Utilizing beet tails.....	22
Different practices.....	6	Summary.....	23
Profitable gains.....	11		

**T**HE BEET-SUGAR INDUSTRY produces five by-products that enter into stock feeding in an important way. These are beet tops (leaves and crowns), pulp, molasses, seed beets, and beet tails.

## BEET TOPS.

Beets are bought by the sugar company from the grower, primarily for their sugar content. In the crown of the beet certain salts accumulate that interfere with the recovery of sugar from the juices, and therefore the grower discards that portion of the beet to which the leaves are attached. These tops are left lying on the ground in the field when the beets are harvested.

## BEET PULP.

After the beet is sliced in the factory the resulting product, commonly called cossettes, is processed through batteries and the saccharine matter is extracted. The remaining fibrous mass is called pulp.

## BEET MOLASSES.

In the process of recovering crystallized sugar from the saccharine juices the negative elements that are found in the beet juices prevent a complete recovery of crystallized sugar, and the residue from this process in the factory is called molasses.

### SEED BEETS.

A considerable quantity of beet seed is grown in the intermountain country. The seed is usually harvested late in July and August. The seed beets that remain in the ground after the seed stalks are harvested, weighing from 6 to 10 tons per acre, carry a sugar content ranging from 5 to 8 per cent or more.

### BEET TAILS.

Handling beets on and off the wagons and at the dumps and in the storage bins causes the "tails" of beets to break off. These tails accumulate usually in catch basins and traps in the flumes at the beet end of the factory. From 2 to 4 tons a day of these accumulate at each factory. In many of them this by-product necessitates a labor expense to cart it away to the refuse heap.

### RATIO OF TOPS TO ROOTS.

The grower who maintains soil fertility that is reasonably rich in available nitrogen will often have as much as 8 tons of tops per acre lying on the field after the beets have been marketed. Other growers will have not more than half that quantity. Many field tests show that when the beet is ready to be harvested and before killing frosts occur, if the topped beets are weighed separately from the tops the weights are about equal. As soon as the tops are cut off, they begin to evaporate moisture, which changes the weight ratio. The beets when left exposed to the sun and wind also evaporate moisture, but the shrinkage in weight is not so rapid as with the tops. When the tops are put into small piles and allowed to remain on the field four or five days, they will weigh about half as much as the marketed beets. There is always some waste in gathering the tops. Sometimes the tops that are gathered from the field will weigh not more than 40 per cent and in other instances they will be in excess of 60 per cent of the weight of the marketed beets. On good soil, where the tops are gathered without undue loss, it is reasonably safe to conclude that about two-thirds of the crop is marketed to the factory.

The studies reported upon in these pages have been made mainly in the States of Idaho and Utah. A conservative estimate indicates that more than 400,000 tons of tops will be produced in these two States from the 1919 crop of beets. At the prevailing price of hay and other feeds, beet-top silage will be worth \$8 or more a ton.

### OBSERVATIONS OF A BEET GROWER.

One extensive beet grower and feeder makes the following deductions:

One acre of beets produces  $3\frac{1}{2}$  tons of cured beet-top silage, which, when fed at the rate of 35 pounds of silage per day per steer, will carry two 1,000-pound steers for a 100-day feeding period.

The acre of beets will also produce 4 tons of green beet pulp, which, when fed to 1,000-pound steers at the rate of 40 pounds per steer per day, will carry two steers for a 100-day period.

The acre of beets will also produce about half a ton of molasses, which, when fed to 1,000-pound steers at the rate of 5 pounds per steer per day, together with the cured silage and pulp mentioned above, will carry two steers for a 100-day feeding period. This ration, together with a moderate amount of alfalfa hay, will fatten and finish beef profitably. This contemplates a feeding capacity at the rate of two steers for a 100-day period for each acre of beets. The planted beet area for the States of Utah and Idaho approximated 150,000 acres for the 1919 season.

These figures are of especial economic interest when it is known that a serious hay shortage occurred in the 1919 crop in both States.

### SAVING THE HAY.

After compiling the data gathered from large numbers of feeders throughout the intermountain country it is found that beet tops

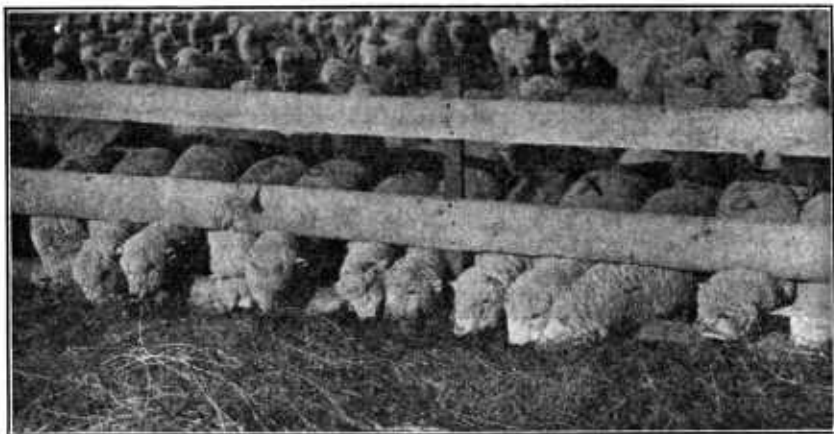


FIG. 1.—Lambs being finished for the market on a daily ration consisting of 3 pounds of beet-top silage and  $1\frac{1}{2}$  pounds of alfalfa hay per head.

when properly made into silage and then feed with alfalfa hay will reduce the hay requirements by approximately one-half. Therefore, beet-top silage will greatly aid in meeting the hay shortage. Beef and mutton gains may be had on a normal basis when the change is substituted. The beef feeder has found that feeding 30 pounds of beet-top silage to a 1,000-pound steer will reduce the hay requirements from 30 pounds a day to 15 pounds a day. Comparable results are had when this ration is applied to the dairy herd. The feeder of sheep has found that a daily ration of 3 pounds of beet-top silage per head will reduce the hay requirements by one-half. (Fig. 1.)

Stock cattle are commonly carried through the winter by feeding 20 to 25 pounds a day of beet-top silage with oat straw. These stock

are found to be in better condition when spring arrives than when fed alfalfa hay only, which is also a common practice in carrying stock cattle through the winter.

With a serious hay shortage confronting the intermountain districts, it is of importance that all available feeds be utilized in the most economical way.

## DIFFERENT PRACTICES.

### GRAZING THE TOPS.

A practice that has been most widely followed has been to turn cattle or sheep upon the fields in the fall, as soon as the beets have been removed, as shown in figure 2. The stock are usually fed upon

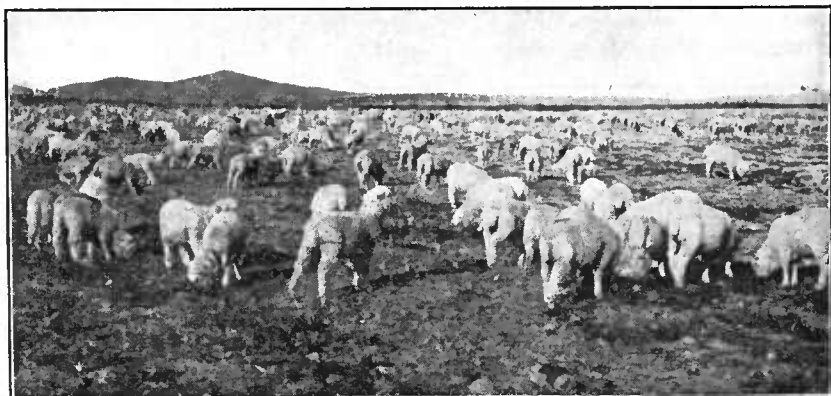


FIG. 2.—Lambs grazing beet tops on a field after the beets are harvested. This method of utilizing the tops involves the least labor. When fed with discretion, lambs will make excellent gains when turned in on the beet fields after harvest. Delay in grazing the tops may also put off fall plowing until freezing weather. Fall plowing is important for the beet crop.

the fields for only a limited time each day, thus regulating the quantity that they are allowed to consume. Because the tops are of an appetizing character, stock will overfeed unless restricted. The salts in the beet crowns are cathartic and tend to scour the animal; hence bad results may follow if the quantity of beet tops consumed daily is not restricted. Sometimes bloating will also cause loss. However, for finishing lambs for market and for carrying stock cattle through, the grazing of beet tops off the field when fed in a regulated way yields excellent results. It is estimated that 1 acre of beet tops will graze one steer for 100 days. Very profitable mutton gains are also often attained by feeding in this manner. This practice involves the minimum amount of labor. When stock are pastured upon the fields, the animal fertilizer is distributed without further labor. Occasionally, lambs and cattle

will become strangled by getting the beet crowns lodged in the throat. If rains occur, the stock may injure the soil by trampling. If early snows come, much of the feeding value of the tops is lost. Where the tops are piled soon after the beets are harvested, as shown in figure 3, there is less wastage, and the stock will feed from the piles even though there should be an early fall of snow. To feed the tops in the field either with or without piling has a serious disadvantage, however, in that plowing can not start until the grazing is finished. In practically all the intermountain beet areas, fall plowing is important. By allowing stock to graze the fields, there is danger of the soil freezing, so that it is not possible to plow in the fall.



FIG. 3.—Beet tops should be put into small piles soon after the beets are topped. When left in piles of approximately 100 pounds, there is little danger of heating. When put into piles, less dirt is gathered and there is less loss by trampling while the beets are being hauled from the field. When piled as above illustrated, the tops may be left two or three weeks before they are put into the silo. If left for a longer period, they will cure and may be safely mixed with straw and stacked as hay is stacked.

Many beet growers conclude that beet tops are worth from \$10 to \$12 an acre when grazed as just described. Where the beet grower does not have stock to utilize the pasturage, it is a common practice to sell the tops in the fields to stockmen at from \$3 to \$6 per acre. When feed is scarce and high priced this pasturage is sometimes sold at higher prices. Outside stockmen have the expense of bringing their stock to the fields, caring for them, and taking them away. Therefore, they do not pay as much for the tops as it is possible for the beet grower to realize by feeding them to his own stock.

#### CURING AND STACKING.

Some growers find it profitable to cure the tops and stack them after the manner that hay is cured and stacked and then feed them throughout the winter. When it is difficult to evaporate and thus



properly "cure out" the tops, straw is intermixed while they are being stacked. This plan contemplates gathering the tops rather promptly after topping and putting them into small piles, as shown in figure 3. A little later they are hauled to the feed yards, where they are stacked. The equipment for loading and hauling the tops is shown in figure 4. Many growers feel that it is more profitable to cure and stack the tops so that they can be fed throughout the winter than to pasture them in the field, as previously described.



FIG. 4.—Gathering beet tops in the field. The wagon with a beet rack is a convenient equipment. Where lack of help prevents hauling the tops from the field soon after the beets are topped, the tops should be put into piles of about 100 pounds each, where they will keep for two or three weeks without seriously deteriorating before they are put into the silo. If left lying loose upon the ground, there will be too much evaporation of moisture and much wastage.

#### SILOING BEET TOPS.

The most profitable practice that has been found for the average beet grower is to silo the tops. This practice is not new or untried. Silage is a succulent feed which, when fed with alfalfa or other hay, has a supplemental value greater than is commonly shown in a study of tables that are compiled from laboratory analyses indicating the comparative food values of different feeds.

The succulent silage stimulates the appetite of the animals and causes them to eat a larger volume of feed than they would consume otherwise. It also furnishes a more nearly balanced ration when fed with hay of alfalfa or some other legume and supplemented with grain.

The accumulated salts found in the crown of the beet constitute the chief reason for cutting it off and leaving it on the field instead

of shipping it to the factory. They seriously interfere with crystallization in the recovery of sugar. As heretofore stated, these salts also have a cathartic property and may scour the animal; but the cathartic properties of beet tops are largely corrected in the fermenting process in the silo. A study of sheep or cattle in the feed lot where beet-top silage is properly fed shows no unusual number of cases of scouring. This indicates that with silage a more profitable use of the food constituents is being made by the animal. After a careful study of this feature the conclusion is reached that profitable beef or mutton gains may be made, even at the finishing stage, where good beet-top silage is a generous part of the ration, and this conclusion is borne out in practice.

Mr. E. R. Brisbin, with a packing company of Butte, Mont., reports that the shipping shrinkage on cattle that are fed and finished where beet-top silage is a generous part of the ration is not greater than the shrinkage commonly found in cattle that are fed and finished with alfalfa, grain, and concentrates. He also states that the dressing percentage of cattle that are largely fed and finished with alfalfa hay and beet-top silage compares favorably with that of the best cattle that they use.

These statements were made after an experience during the feeding period of 1918-19. This period involved the feeding and finishing of 2,250 head of steers fed by 32 different farmers growing sugar beets in the upper Snake River valley of Idaho, where beet-top silage was extensively used.

These cattle were delivered to the beet growers from the range in November, 1918. Marketing began on February 10 and was concluded about April 1, 1919. The 2,250 steers showed an average gain of 170 pounds per head. The average spread in the price of the feeders and the finished cattle was  $2\frac{1}{2}$  cents per pound. The beet growers in some instances pastured the cattle upon their different fields for a time after receiving them, but they were fed and finished mainly with alfalfa hay, beet-top silage, and beet pulp. The most satisfactory practice was to start with pulp and hay and later add the silage, finishing with about 30 to 35 pounds of silage and 15 to 20 pounds of hay per day. Not many feeders used grain. Several used a light spread of beet molasses upon the pulp or hay. After making deductions for the market price of hay and all other feeds and also for wages for the time spent in feeding, the 32 beet growers made a net profit of more than \$40,000 in feeding this lot of steers. This did not credit the operation with the several thousand tons of manure which was later spread upon the beet fields, thus greatly aiding to maintain soil fertility.

John Stosich was one of the most successful of the 32 feeders. His 26 steers were delivered to him on November 22, 1918, at an average weight of 1,018 pounds. On March 11 they were weighed out at 1,265 pounds gross, showing a gain of 247 pounds per steer. During the first three weeks the steers were grazed on the fields, gleaned feed from along the fences, irrigation ditch banks, and the autumn growth on the grain and other fields that otherwise would have been waste. On December 15 they were started upon a light feed of hay and about 75 pounds of wet beet pulp per head each day. The pulp was gradually increased to 140 pounds. On February 1 beet-top silage was mixed with the hay and pulp. The pulp was gradually decreased, and finally the beet-top silage was entirely substituted for it, finishing the steers on 30 pounds of silage and less than 20 pounds of alfalfa hay daily. The steers produced 225 loads of manure, which Mr. Stosich spread upon 15 acres that were seeded to beets in April, 1919.

These results are mentioned in detail because they illustrate an entirely profitable method of marketing surplus hay with the beet tops and other farm-grown feeds. At the same time they produce a fertility that renders it possible to increase the beet tonnage and makes for more profitable farm crops.

Siloing and feeding the beet tops mixed with pulp, hay, and molasses were the incentives which started the beet growers in this particular district to feeding cattle. They would not have undertaken to do the feeding had it not been for the increased supply of feed they had secured as a result of siloing their beet tops. Their winter profits in the feeding operations handsomely supplemented their earnings from the growing of crops during the summer. They had no worry about marketing and delivering surplus hay. They were enabled to fertilize properly an increased acreage and to meet the perplexing problem of maintaining soil fertility. This procedure has stabilized the beet crop with these growers, and it has also greatly aided them in establishing a crop rotation, which is seriously needed in most beet-growing areas. Making better use of the beet tops will reduce the hay requirements and allow part of the alfalfa land to be plowed. More feeding means more manure available on the farm, while better fertilized soil allows other intensive crops to be grown profitably in rotation with beets, grain, and alfalfa. The procuring of the steers and the supervision of their feeding were done by an experienced feeder employed by a sugar company. The entire enterprise also had the assistance of the farm bureau and the extension division of the University of Idaho.

## PROFITABLE GAINS.

A sugar company in Colorado owns and operates several thousand acres of land tributary to its sugar factories, feeding regularly several thousand head of cattle. One lot of 135 steers made an average gain of 2.3 pounds per head daily in a period of 115 days, counting the shrinkage in buying on the Denver market and on the outshipment to the Kansas City market. This company found the following ration per steer per day to be good: 25 pounds of beet-top silage, 60 pounds of beet pulp, 10 pounds of alfalfa hay, 4 pounds of beet molasses, and 3 pounds of cottonseed cake. Accurate records of the operations showed a labor cost of 70 cents per ton for hauling the tops and filling the silo. This company calculates that cured silage was produced at the rate of 35 per cent of the weight of the marketed beets and that a heavy crop of beets will yield from 5 to 6 tons of silage per acre of beets. A 10-ton crop of beets has yielded  $3\frac{1}{2}$  tons of cured silage per acre. In estimating siloing capacity (the earth-silo type) about 38 cubic feet for each ton of beet tops is calculated, allowing a settling of 12 inches for a well-packed silo 5 feet in depth. The following analysis of beet-top silage, comparing it with the standard analysis of corn silage, was made at the company's laboratory:

*Comparative analyses of beet-top and corn ensilage.*

Constituents.	Beet-top silage. <sup>1</sup>	Corn silage. <sup>2</sup>
Molsture.....	64.36	68.50
Ash.....	9.25	1.51
Crude protein.....	2.87	3.12
Crude fat.....	.44	.80
Crude fiber.....	5.46	6.53
Nitrogen-free extract.....	17.62	20.54

<sup>1</sup> It is possible that silage produced from beet tops grown in other localities might show a higher or a lower feeding value.

<sup>2</sup> The analysis here given for corn silage is considerably higher than the generally accepted standard analysis for this product.

<sup>3</sup> Dirt gathered with the tops makes a high ash content.

## A VALUE NEARLY EQUAL TO ALFALFA HAY.

A firm of extensive feeders in the northern Colorado district after an experience of several years says—

We believe 1 ton of tops properly siloed is worth almost, if not altogether, as much as a ton of alfalfa hay for feeding to cattle. Any farmer, regardless of the size of his beet field, can cheaply make a pit, save all of his tops, and feed them at any time, as there is no limit to the time that they will keep. We have been very successful in getting good gains on our cattle since we started feeding them in this way.

## COLLATERAL VALUES.

The average beet grower concludes that 2 tons of good beet-top silage is worth 1 ton of good alfalfa hay. Very few men who have fed the silage think that it has a value less than 50 per cent of the value of hay. Those who consider the value as great as the estimate above quoted probably reach conclusions that are not entirely based upon the intrinsic value of the silage. There are two collateral values in the silage that are not shown in the laboratory analyses, namely, (1) the succulent character of the feed, which stimulates an appetite in the animals and causes them to consume greater quantities than where dry, cured feeds only are used; and (2) the beet-top silage when fed with alfalfa hay helps to balance the ration and causes the animal to utilize better all the feed consumed.

## EXTENSIVE FEEDING TESTS.

A firm of extensive beet growers in Idaho feeds several thousand sheep and grows from 75 to 150 acres of beets each year. For two successive seasons they have made and fed about 500 tons of beet-top silage. They recently made the following statement:

We did not keep check on all of our feeding all winter, but we weighed the feed to some of the herds of sheep long enough to satisfy ourselves that a ton of beet-top silage is worth as much as a ton of hay. We have also proved to our own satisfaction that beet-top silage for fattening sheep and cattle is cheaper and will fatten quicker than grain or corn. We think that the tops, if gathered immediately after being cut off, will weigh half as much as the beets.

It should be noted that the above statement is based upon observation rather than upon actual test by weight, but it shows what value the growers place upon beet-top silage used as a stock feed. The growers referred to above find that by feeding 3 pounds of beet-top silage per head per day they can reduce the hay requirements for sheep more than half.

After an experience of two seasons with beet-top silage a successful Idaho feeder offers the following suggestions:

The beets should be topped from windrows or piles and the tops gathered immediately, free from dirt, and placed in small piles or hauled directly to the silo. Pack firmly in the silo. If the silo is located on sandy soil, build a concrete retaining wall for each side. It is important to eliminate the dirt. Three pounds of beet-top silage per head per day were fed for a period of 40 days to 800 head of sheep, about one-half ewes and one-half lambs, which made a gain of 4 pounds per head more than sheep of like quality that were fed entirely on beet pulp and hay. The silage comes out warm, even in mid-winter, and is greatly relished by the sheep.

This feeder made 125 tons of silage from 25 acres of beets. It cost him about \$1 per ton to gather and silo the tops.

## UNANIMOUS APPROVAL.

As against the very few adverse experiences which have been reported, the following statement taken from the Farm Bureau News, the official organ of the Sevier County (Utah) Farm Bureau, is offered:

Without an exception, every man who siloed beet tops last year reports excellent results and savings from the feed that it furnished. Most of the farmers reporting rate the value of the silage at about 2 tons of silage equal to 1 ton of the best alfalfa hay. One or two men say that it is nearly equal in feeding value to alfalfa hay.

## A GOOD DAIRY FEED.

In the Weber County (Utah) Farm Bureau News, Mr. James G. Widdison, jr., says:

About the first of January I opened the silo and found that the tops had kept perfectly. The cows relished them as much as they did the fresh tops, and they did much better when fed only a limited amount than when allowed to run at will on the tops in the field. The milk produced was also of good quality and had no disagreeable flavor that is sometimes complained of when cows are fed beet pulp. I have no accurate information as to feed value in pounds, but would say that a ton a week fed to six cows would enable them to do nicely on the hay that one cow would eat if fed hay only. I find it also a convenient and valuable feed for pigs. I have decided that beet-top silage shall have a place in my winter feed from now on, even though its care requires a good deal of time in our busiest season, which many farmers complain of.

## ADVERSE EXPERIENCES.

## FEEDING AGED EWES.

One man had bad results in feeding beet-top silage to aged ewes. Samples were taken from the silo. The analyses indicated that the silage was normal. It is likely that the chief cause of trouble was the feeding to weak ewes of too much of the succulent silage at the outset. In most instances, those who use aged ewes find that silage will cause them to produce more milk for their lambs than they otherwise would, which allows them better to sustain their usual large percentage of twin lambs. Two instances were reported where the milk flow was excessive when beet-top silage was fed to aged ewes, and the udders became swollen and feverish and gave trouble in this respect. Beet-top silage should always be fed lightly at the start.

## FEEDING STEERS.

In another instance an extensive feeder lost several head of steers while feeding beet-top silage. The tops were gathered carefully from a sandy soil. The silo was located on a sandy spot. It is

difficult to gather tops from a sandy field and then silo in sandy earth with sandy side walls in a pit silo without having an excessive proportion of sand in the silage. In some instances as much as 5 per cent of the net weight of the silage was found to be sand and dirt. Compacting in the stomach of the animal is almost sure to follow when there is much sand or dirt in the silage.

#### BEWARE OF MOLDY SILAGE.

Steers have died as a result of improperly feeding hay and grain. It is important that the moldy silage that is found on and near the surface or sides of the silo be carefully removed and destroyed. Moldy silage is even more dangerous than moldy straw or moldy hay. These often cause loss with animals.



FIG. 5.—A long, deep type of earth silo, 10 feet wide at the bottom. The location is on a well-drained hillside convenient to the feeding yards. The earth is a stiff clay, and the sides remain solid and firm. On sandy soil it is recommended that concrete retaining walls be put in, to prevent the soil from getting mixed with the silage.

In a few instances horses were allowed to get to the beet-top silo and gorge themselves. Even good silage is not recommended for horses, pigs, or calves. Moldy silage is almost sure to cause trouble if fed to any kind of stock. The total number of bad results reported from the feeding of beet-top silage is very small.

### THE BEST PRACTICES

#### PILING THE TOPS.

It is important that the tops and crowns be gathered free from dirt. With an ordinary fork the dirt can be readily shaken off the tops if they are gathered while still fresh. When placed in small piles of approximately 100 pounds to the pile, as shown in figure 3, there will not be a sufficient quantity to heat. In these small piles

the loss through evaporation is not great, even though the piles are allowed to remain on the fields for two weeks before they are hauled to the silo. Collecting in small piles facilitates driving teams with wagons while gathering the beets from the fields without trampling the tops. A flat-top rack on a low-wheeled wagon or an ordinary dump type of beet rack is convenient for hauling the tops from the field to the silo. When such a pit silo as is shown in figures 5 and 6 is used the team with the loaded wagon is driven through the silo and the tops are dumped and then scattered and packed in the silo, as seen in figure 6. There are two disadvantages in this practice. There is a tendency to dump the tops too much into piles instead of spread-



FIG. 6.—The natural earth or pit silo is constructed with sloping ends, so that the team and wagon may be driven over the mass of tops. Dumping the tops as here illustrated has two disadvantages, however. The tops are usually not well spread, and therefore the mass settles unevenly. All the dirt that may be gathered with the tops is also dumped into the silo, whereas if the tops were forked from the wagon alongside and then spread there would be less dirt in the silage. At the far corner is shown an illustration of the method of placing straw at the edge of the mass of tops before the earth is drawn against the sides. It is important to keep the dirt from getting mixed with the silage.

ing, and the packing is liable to be irregular, and all the dirt that is thrown on the wagon in gathering the tops is dumped into the silo. If the wagon is driven alongside the silo and the tops forked off much less dirt will get into the silo. It is important to have the tops spread evenly in the silo; otherwise the settling will be irregular.

#### THE ADDITION OF SALT AND STRAW.

Five pounds of salt spread with each ton of green tops improves the quality of the silage. Straw may be spread with alternate layers of beet tops, as shown in figure 7, provided the tops are put



in while still fresh. Straw is not recommended where the tops have evaporated much moisture. Very much more thorough packing is required where straw is used.

#### TYPE OF SILO.

The concrete (fig. 8), stave, or other type of silo structure commonly built for making corn silage may be used for siloing beet tops. Where these structures are used, it will be best to run the

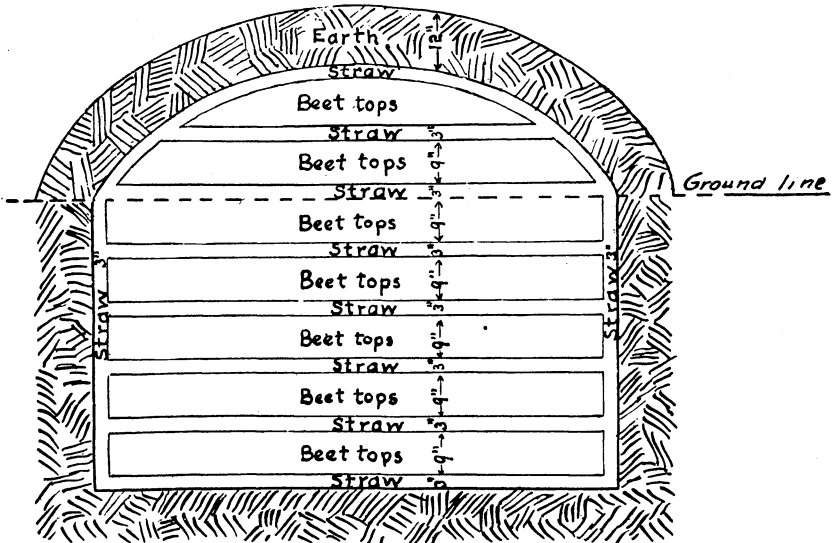


FIG. 7.—Sectional view of an earth silo. The quantity of silage may be increased by alternating layers of straw with beet tops. It is absolutely necessary that the tops be gathered while fresh, with an abundance of moisture to facilitate packing when straw is used. The use of straw requires about twice as much packing as otherwise would be necessary. It is imperative that all free air be excluded. Unless proper precautions are observed it is best not to alternate with layers of straw. It is always a good plan to put a layer of straw in the bottom, against the sides, and on the top, to aid in keeping dirt from the silage.

tops through the usual cutting device, much as corn silage is treated. It is suggested that the tops be forked from the wagon to an open slatted table attached to the cutter, so that the dirt will sift through and not get into the silo. Because beet tops pack more solidly than chopped corn silage, the outthrust is greater and silos sometimes crack and leak when filled with beet tops. Sometimes the corn silo is not entirely filled and it is reasonably safe to finish filling the silo with beet tops, provided the structure is well built.

It is not necessary to erect an expensive perpendicular silo for beet tops. The horizontal type, using the excavated pit with earthen sides, as shown in figure 5, or concrete retaining-wall sides, as seen in

figure 8, is less expensive and entirely efficient if care is used in filling. Figure 9 shows the process of excavating a pit silo.

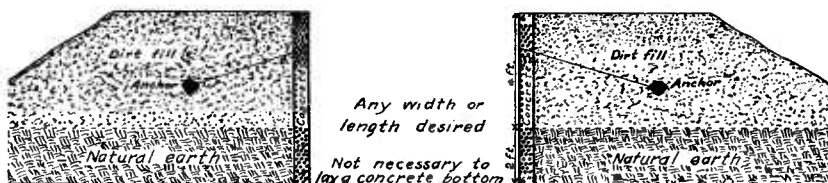


FIG. 8.—The horizontal concrete silo; illustrating a plan for a silo with concrete retaining walls built perpendicular and smooth. This facilitates solid packing at the edges and makes it possible to exclude the air. The wall is anchored at intervals to prevent its being pushed in when the heavily loaded wagon is driven over the dirt fill. Much less dirt goes into the silo when the tops are forked from the wagon into the silo. The width should be sufficient to allow driving the team and wagon through to pack the tops and also to load in taking out the silage. Good drainage is essential.

The dimensions of the pit silo may vary according to the quantity of material that is to be siloed. The construction shown in figure 9 is better than a square or a circular shape.



FIG. 9.—A county agricultural agent and a sugar-company agriculturist demonstrating the method of excavating for a beet-top silo. Most of the excavating can be done with a team and scraper. The sides may be shoveled by hand. The dimensions can vary according to the quantity of tops to be siloed.

When the tops are packed to a depth of 5 to 8 feet, the free air is better excluded and a better quality of silage is made.

A long deep pit, like the one shown in figure 5, is better than a broad shallow pit. Earth may be drawn against the sides and firmly packed where the tops are heaped above the surface earth or retaining wall.

Where the water table comes near the surface, excellent silage may be made by stacking the tops entirely aboveground, as seen in figure 10. The wastage, however, is greater. In any event, the tops should have sufficient moisture in them to facilitate compression in packing the mass, giving the silage the solid appearance shown in the cross section in figure 11. The free air must be entirely excluded; otherwise bacteria which cause putrefaction will enter and spoil the silage.



FIG. 10.—A beet-top silo above the ground level. In this instance, the tops were piled alongside a stack of hay. After packing them down thoroughly, they were covered with several inches of fine, chaffy straw, which effectually sealed the fermented mass. Analyses showed a quality of silage that compared with the best. With this type of silo, the ratio of spoilage is greater, but the plan is entirely feasible, particularly where the water table prevents excavating for the earth silo.

#### METHODS OF PACKING.

With the horizontal silo it is a common practice to drive the team and wagon right through the silo from one end to the other. A gradual incline at both ends facilitates entering and leaving. In a few instances beet growers have driven a tractor over the tops in the silo. This is an excellent way to pack the mass thoroughly. Sometimes a boy will ride a horse repeatedly over the tops in the silo. It is imperative that the packing be thorough or the product will be disappointing.

## SEALING THE SILO.

After the mass of tops has been well packed and the silo is ready to be closed, provision must be made to seal the mass as nearly airtight as possible. Fine, chaffy straw spread to a depth of 8 or 10 inches is effective. Sometimes a thin layer of straw is spread and then 8 to 12 inches of earth is placed on top of the straw.

The best and most economical method of sealing consists in covering with beet pulp to a depth of a foot or more, as seen in figure 12,



FIG. 11.—A cross-sectional view of a large beet-top silo, illustrating the manner of cutting out and removing the silage. An ordinary hay knife is used to cut the silage. It will be observed that the top contour of the silo is rather regular, showing that the filling and packing were uniform and thorough.

and is the method recommended. Those living too far from the beet-sugar factory to haul the pulp can afford to have a quantity shipped. Pulp is a good, cheap feed, and an excellent way to store it is on top of the silo. The fermenting of the beet tops generates a gaseous heat, which aids in ripening the pulp, thus making a superior feed. It also keeps the pulp from freezing in cold weather. Freezing has always been annoying to feeders in the colder districts. The silo should be located convenient to the feeding yards. It is worth while to have this mass of warm, processed, high-grade feed near to the feeding yards rather than to depend upon hauling supplies throughout the

winter, when the roads and weather are forbidding much of the time. The wet pulp is heavy and flexible and aids to settle the mass of tops.

#### OPENING THE SILO.

A hay knife (see fig. 11), such as is commonly used on most farms, will cut the cured silage and pulp covering into "bents," much as a rick of hay is cut down when the hay is being taken away.

The cured pulp may be fed in the same way that the silage is fed. The covering for the silo should be so rounded that drainage will be perfect. Surface water should not be permitted to stand around or on the silo.

After the mass has fermented for a period of four to six weeks, the large hay knife may be used and the silage cut across one end, from top to bottom, and forked out as needed. When spring arrives, any unused part of the silage may remain for

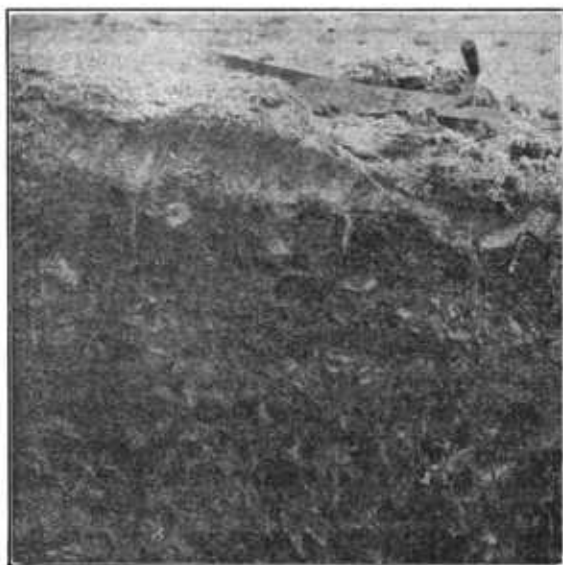


FIG. 12.—Sectional view of a beet-top silo that was covered with beet pulp. The pulp is heavy and flexible and settles as the tops in the silo settle. It seals the top of the silo, and the heat from the fermenting silage keeps the pulp covering from freezing. This is an excellent way to store green pulp.

future use. There will be some spoilage if the silage is exposed. The same precautions should be observed about spoilage as will be necessary in feeding corn silage from a regular structure. Any fermented product is liable to be attacked by bacteria that cause decay if exposed to the air for any considerable length of time. Precaution in this respect is not so important in the winter as during the warm spring and summer months, when bacteria are more active

#### WET BEET PULP.

The value of beet pulp as a supplemental feed becomes better established with the experience of each succeeding season. It is not a complete feed and should always be given in conjunction with a legume hay and other feeds. It is fed to beef cattle and sheep and

also to dairy stock. When given to dairy cows it should be fed after the milking period in order to avoid the possibility of a bad odor and a disagreeable taste in the milk. Pulp is heavy to handle and to haul. Where feeders are conveniently near to a factory pulp silo it is a common practice to haul the pulp as wanted during the winter. The gases caused by the fermenting process keep the mass of pulp in a large silo from freezing in cold weather. The best way for the average beet grower to store the pulp on the farm is to spread it on top of the fermenting mass of beet-top silage. Freezing is thus largely eliminated.

### **DRY BEET PULP.**

Some beet-sugar factories have installed equipment for drying the green pulp. By this process the moisture content of 95 per cent is reduced to 12 per cent. The feeding value is but little changed. The use of this process makes it possible to ship the pulp to more distant markets, and it also obviates annoyance from freezing.

### **UTILIZING BEET MOLASSES.**

The most economical way to use beet molasses is to make a mixture with chopped or ground alfalfa hay or straw. Mixing devices are arranged to deliver a definite percentage of molasses and automatically to distribute the mixture uniformly. Where chopping or grinding devices are not available, it is entirely possible to make economical use of the molasses by sprinkling it over hay, straw, or pulp at feeding time, using a hand sprinkler. The Colorado Agricultural Experiment Station shows a value for beet molasses in equivalent terms of 1 pound of molasses equal to three-quarters of a pound of rolled barley. In addition to the intrinsic value of molasses it has a supplemental value, because it is appetizing to stock, apparently lending a zest to their use of other feeds.

Beet molasses is not recommended for feeding to pregnant cows, sows, or ewes, nor to pigs, calves, colts, or young lambs. Care must be used in feeding molasses to horses. Only a limited quantity should be fed, and it should be thoroughly mixed with other feeds.

### **DIGESTIBLE NUTRIENTS AND BALANCED RATIONS.**

In a paper which was read before the American Association of Sugar-Beet Agriculturists at the recent convention at Logan, Utah, Mr. R. C. Kibbey, of Colorado, offered the following:

Comparing the relative total digestible nutrients contained in 100 pounds of corn with those contained in an equal weight of sugar-beet by-products, we have the following: Corn equals 1; beet molasses, 0.68; dry beet pulp, 0.87; wet beet pulp, 0.09; beet-top silage, 0.21; dry beet tops, 0.64.

TABLE I.—*Sugar-beet by-products, showing the maximum weights of each which may be profitably included in rationing different classes of animals.*

Classes of stock.	Weight of ration per head per day (pounds).					
	Beet tops.		Pulp.		Molasses.	Tails, fresh.
	Siloed.	Dried.	Cured.	Dried.		
Fattening steers (1,000 pounds weight).....	30 to 40	20	60 to 100	6 to 10	4	40
Fattening cows (800 pounds weight).....	32	16	80	8	3	32
Young cattle (600 pounds weight).....	24	12	40	4	2	25
Fattening bulls (1,200 pounds weight).....	48	24	150	15	5	50
Dairy cows.....	30	15	60	6	3	25
Fattening sheep.....	3	1½	10	1	3	4
Ewes suckling lambs.....	3	1½	10	1	.....	4
Fattening hogs.....	.....	3	.....	2	1½	3

## MANAGEMENT OF SEED-BEET FIELDS.

### GRAZING SEED BEETS.

When the crop of beet seed is harvested, there remains in the ground the seed beets. These beets weigh from 6 to 10 tons per acre. The sugar content ranges from 5 to 8 per cent or more.

Sometimes irrigation water is turned into the field as soon as the beet seed is harvested. Following the irrigation a rank growth of green tops comes on and furnishes excellent grazing for cattle or sheep during the months of September and October.

Another method is to plow the beets out of the ground, so they will be readily available, and then graze them with sheep or other stock. If the beets are left exposed to the sun and elements very long they become hard and fibrous.

### SILAGING SEED BEETS.

Experiments indicate that it is entirely feasible to chop the seed beets so they may be packed into a mass in a silo, in much the same way that beet tops are packed. An excellent quality of silage can be made, and it may be fed at any convenient time. Silage in this form has a fattening value comparable to beet-top silage.

### UTILIZING BEET TAILS.

At the factory beets are carried from the storage bins in flumes filled with water. As they go over the dumps and through the various conveyors the tips, or tails, of the beets are broken. At intervals catch basins accumulate these tails, and they are forked into piles near the beet end of the factory. From 2 to 4 tons a day accumulate at each factory in this way. They may be fed while fresh or may be put into a beet-top silo. In either case they make excellent feed. In one instance where the beet tails were siloed it was found that sheep and other stock preferred this silage to that made from beet tops.

## SUMMARY.

A good crop of beets will yield from  $3\frac{1}{2}$  to 6 tons of processed silage.

The average cost of gathering the tops and filling, packing, and finishing the silo is about \$1 a ton.

It is extremely important that the tops be gathered and put into small piles promptly after the beets are topped. The dirt may be easily shaken from the tops while the leaves are still fresh. *It is imperative that dirt and sand be eliminated.*

The fundamental factors that are involved in making good corn silage also apply in making beet-top silage. Pack the mass thoroughly to exclude the free air and then seal tight. Good silage requires thorough packing.

It is not necessary to run the tops through a silage cutter. Some feeders prefer to do so, however, to avoid the possibility of lambs choking on the crowns.

The same structure that is commonly used for putting up corn silage may be used for beet-top silage. Because beet tops pack in a very dense mass, the structure will sometimes crack and spread and thus allow air to enter. A well-built silo is reasonably safe.

Making beet-top silage does not necessarily involve a cash outlay for materials. The natural earth silo and stacking above the earth are both successful. Concrete side retaining walls are advisable under certain conditions, however.

The natural earth silo will yield just as good results for beet-top silage as the perpendicular structures, but greater care in packing is necessary.

An excellent quality of silage is made by stacking the tops entirely above the earth and then packing them thoroughly. The spoilage loss is greater than when the structure or the pit silo is used.

It is not necessary to alternate layers of tops with layers of straw. It is always advisable to put a layer of straw next to the earth bottom and sides, to eliminate dirt from the silage. When straw is intermixed with the tops more packing is necessary.

Silage is not a balanced ration. It should always be supplemented by other feeds.

Silage is a carbohydrate feed and balances with alfalfa hay, which is rich in protein.

The fermenting process in the silo largely corrects the cathartic salts in beet tops.

The most profitable use is made of beet tops when they are siloed and fed with alfalfa hay or other forage and possibly supplemented with grain or concentrate feeds.

Gathering beet tops from the field and siloing them without undue delay allows fall plowing to be done before freezing weather interferes. Fall plowing is important for the beet crop.



The best feeding practices have demonstrated that by the use of beet-top silage in the ration the hay requirements may be reduced by one-half in feeding for the production of beef, mutton, or milk. The succulent value of the silage supplements its actual feeding properties and that of forage and other feeds.

Unwise feeding practices will produce bad results in feeding silage or molasses. A systematic study indicates that the losses have been due to the manner in which silage is fed or to an excess of dirt rather than to be fed.

Beet-top silage will increase the flow of milk of ewes at lambing time. It is best to start feeding only about 1 pound per head daily and gradually to increase the quantity to 3 pounds per day. The udder may become feverish if this caution is not observed.

The most economical use of beet-top silage calls for about 30 pounds daily for each steer or cow and about 3 pounds for each sheep. Always begin with a light ration.

Beet molasses has a definite feeding value, particularly when mixed with chopped or ground hay or straw. Successful feeders recognize its value when given in regulated quantities.

The best way for the beet grower to store pulp for winter feeding is to spread it over the beet-top silo. It effectually seals the silage mass, and the heat from the silage warms the pulp and thus hastens the curing process; it also reduces the annoyance of handling frozen pulp.

The limiting factor in growing sugar beets is usually the acreage that can be suitably fertilized and fitted for the crop, due regard being given a crop rotation. More feeding on the farm means more manure for the fields.

The economic utilization of beet tops and other by-products not only yields a direct profit by feeding to stock, but greatly assists in maintaining soil fertility and also in establishing a better crop rotation.

The by-products of the sugar-beet crop when properly handled and fed have a value equal to the entire cost of what is commonly termed "hand labor" in producing the crop of beets.

The best practices of feeding the by-products of the sugar-beet crop will yield a net profit equal to half the net profits usually had in growing and marketing the crop of beets.

It is safe to conclude that 1 ton of good beet-top silage is equal to half a ton of alfalfa hay when fed as a mixed feed. Many feeders think that the silage has a value almost equal to good hay, ton for ton.

Beet-top silage comes out of the silo warm in the winter, and it is appetizing. It seems to stimulate the assimilation of food and to aid the animal to appropriate the maximum values from all the feeds consumed.

The silo brings the feed near the feeding yards and minimizes waste.